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PTO/SB/05 (4/98)
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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 C.F.R. § 1.53(b))

Attorney Docket No. TES:7356.003
First Inventor or Application Identifier David Curt Morris
Title HELICOPTER BLADE ASSEMBLY ADAPTED...
Express Mail Label No. EL168606799US

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

1. ☒ * Fee Transmittal Form (e.g., PTO/SB/17)
(Submit an original and a duplicate for fee processing)
2. ☒ Specification [Total Pages 10]
(preferred arrangement set forth below)
 - Descriptive title of the Invention
 - Cross References to Related Applications
 - Statement Regarding Fed sponsored R & D
 - Reference to Microfiche Appendix
 - Background of the Invention
 - Brief Summary of the Invention
 - Brief Description of the Drawings (if filed)
 - Detailed Description
 - Claim(s)
 - Abstract of the Disclosure
3. ☒ Drawing(s) (35 U.S.C. 113) [Total Sheets 15]
4. Oath or Declaration [Total Pages 25]
 - a. ☐ Newly executed (original or copy)
 - b. ☒ Copy from a prior application (37 C.F.R. § 1.63(d))
(for continuation/divisional with Box 16 completed)
 - i. ☐ DELETION OF INVENTOR(S)
Signed statement attached deleting inventor(s) named in the prior application, see 37 C.F.R. §§ 1.63(d)(2) and 1.33(b).

* NOTE FOR ITEMS 1 & 13: IN ORDER TO BE ENTITLED TO PAY SMALL ENTITY FEES, A SMALL ENTITY STATEMENT IS REQUIRED (37 C.F.R. § 1.27), EXCEPT IF ONE FILED IN A PRIOR APPLICATION IS RELIED UPON (37 C.F.R. § 1.28).

ADDRESS TO: Assistant Commissioner for Patents
Box Patent Application
Washington, DC 20231

5. ☐ Microfiche Computer Program (Appendix)
6. Nucleotide and/or Amino Acid Sequence Submission (if applicable, all necessary)
 - a. ☐ Computer Readable Copy
 - b. ☐ Paper Copy (identical to computer copy)
 - c. ☐ Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

7. ☐ Assignment Papers (cover sheet & document(s))
8. ☐ 37 C.F.R. § 3.73(b) Statement of Power of Attorney (when there is an assignee)
9. ☐ English Translation Document (if applicable)
10. ☐ Information Disclosure Statement (IDS)/PTO-1449 ☐ Copies of IDS Citations
11. ☐ Preliminary Amendment
12. ☒ Return Receipt Postcard (MPEP 503)
(Should be specifically itemized)
13. ☐ * Small Entity Statement(s) ☒ Statement filed in prior application, Status still proper and desired (PTO/SB/09-12)
14. ☐ Certified Copy of Priority Document(s) (if foreign priority is claimed)
15. ☐ Other: _____

16. If a CONTINUING APPLICATION, check appropriate box, and supply the requisite information below and in a preliminary amendment:

☒ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No: 08 / 730,871
Prior application information: Examiner Verdier, C. Group / Art Unit: 3745

For CONTINUATION or DIVISIONAL APPS only: The entire disclosure of the prior application, from which an oath or declaration is supplied under Box 4b, is considered a part of the disclosure of the accompanying continuation or divisional application and is hereby incorporated by reference. The incorporation can only be relied upon when a portion has been inadvertently omitted from the submitted application parts.

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JC551 U.S. PTO
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06/09/99

HELICOPTER BLADE ASSEMBLY ADAPTED
TO PERMIT RAPID FORWARD FLIGHT

This application is a continuation of U.S.
5 Patent Application 08/730,871 filed October 18, 1996.

TECHNICAL FIELD

The present invention relates to helicopters. More
specifically the present invention relates to a
10 helicopter blade assembly.

BACKGROUND OF THE INVENTION

The helicopter, when introduced, was a
revolutionary aircraft. With its ability to take off and
15 land vertically, the helicopter was able to accomplish
maneuvers that no fixed wing craft could perform.
Unfortunately, the aerodynamics of rotating blades impose
a limit on helicopter maximum forward speed (apart from
drag, motive power and other considerations).

20 The standard single, tandem or lateral-twin
rotor helicopter blades provide lift as well as forward
impetus. Even with the addition of independent
propulsion from either a propeller or jet engine, the
individual blade flight characteristics present the
25 following problem at high speeds. In forward flight, a
blade advances into the airstream and then retreats. In
high speed forward flight, the retreating blade speed may
match the speed of the advancing airstream, producing a
zero lift condition. The advancing blade then carries
30 the full lift load, with a destabilizing overturning
moment on the craft itself. At speeds below this
condition, cyclic pitch control can successfully
compensate for the potential instability. There is a
tilt-rotor design which solves this problem by directing
35 the forced flow of air in the direction required, by
rotating engines and blades altogether. The following is

offered as a less complex mechanical solution to this problem.

SUMMARY OF THE INVENTION

5 The present invention is a helicopter blade assembly for a craft with either one or two blade-sets. The blade assembly is constructed so that the rotation of the blades provides lift during takeoff and landing. During- rapid forward flight, however, the blades sweep
10 out the shape of a virtual disk that acts as a lifting body, so that as the virtual disk cuts rapidly through the air it generates lift. The aircraft to which the assembly is attached requires an independent means of forward propulsion (such as a propeller or jet engine)
15 because the blade assembly is generally not used to pull the helicopter through the air in the same manner as do conventional helicopter blade assemblies.

 The shape and, therefore, the lift characteristics of the "swept" disk are controlled by
20 governing the camber of the blades as they rotate, thereby creating the equivalent of ailerons on a fixed wing. This would allow a craft to execute turns and other maneuvers.

 Additional objects and advantages of this
25 invention will be apparent from the following detailed description of preferred embodiments thereof which proceeds with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

30 FIG. 1a is a bottom view of a rotatable helicopter blade assembly according to the present invention;

 FIG. 1b is a side view of the rotatable helicopter blade assembly of FIG. 1a;

35 FIG. 2a is a bottom view of the rotatable helicopter blade assembly of FIG. 1a configured to produce a greater symmetrical camber;

FIG. 3a is a bottom view of the rotatable
5 helicopter blade assembly of FIG. 1a configured to
produce an asymmetrical camber;

10 FIG. 4a is a bottom view of the rotatable
helicopter blade assembly of FIG. 1a configured to
produce an alternative asymmetrical camber;

FIG. 5a is a bottom view of the rotatable helicopter blade assembly of FIG. 1a configured to produce a symmetrical camber, and shown while rotating.

FIG. 6a is a bottom view of the rotatable helicopter blade assembly of FIG. 1a configured to produce an asymmetrical camber and shown while rotating.

FIG. 7a is a bottom view of an alternative rotatable helicopter blade assembly according to the present invention.

FIG. 8a is a bottom view of the alternative rotatable helicopter blade assembly of FIG. 7a, configured to produce an asymmetrical camber.

FIG. 8b is a side view of the rotatable helicopter blade assembly of FIG. 7a configured to produce a greater asymmetrical camber.

FIG. 9a is a bottom view of an additional
5 alternative rotatable helicopter blade assembly according to the present invention.

FIG. 9b is a side view of the rotatable helicopter blade assembly of FIG. 9a.

FIG. 10a is a bottom view of the alternative
10 rotatable helicopter blade assembly of FIG. 9a, configured to produce a symmetrical camber.

FIG. 10b is a side view of the rotatable helicopter blade assembly of FIG. 9a configured to produce a symmetrical camber.

FIG. 11a is a bottom view of the alternative
15 rotatable helicopter blade assembly of FIG. 9a, configured to produce an asymmetrical camber.

FIG. 11b is a side view of the rotatable helicopter blade assembly of FIG. 9a configured to
20 produce an asymmetrical camber.

FIG. 12a is a bottom view of the alternative rotatable helicopter blade assembly of FIG. 9a, configured to produce an alternative asymmetrical camber.

FIG. 12b is a side view of the rotatable
25 helicopter blade assembly of FIG. 9a configured to produce a greater alternative asymmetrical camber.

FIGS. 13a-13d are side views of additional alternative rotatable helicopter blade assemblies according to the present invention.

30

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

A preferred embodiment of a rotatable blade assembly 10, according to the present invention is shown in FIGS. 1a-4b. Each of blades 12 has a hinge 14 between
35 a distal end 16 and a proximal end 18. Each proximal end 18 is fixedly mounted to a mast 20. A connector 22 connects each distal end 16 to a collar 24, which is

rotatably mounted about a vertically adjustable circular track element 26, which itself is vertically adjustably mounted about horizontally adjustable hollow post structure 28. In greater detail, connector 22 connects
 5 radially projecting eyelet 30 of collar 24 with downwardly projecting eyelet 32 of blade 12, so that as blades 12 rotate, collar 24 is pulled about a circular track 34 of track element 26. A pair of rollers 36 help to guide each connector 22. Hollow post structure 28 is
 10 horizontally adjustably mounted to a circular plate 38 which forms a portion of the frame of a helicopter.

A vertically oriented actuator 44, typically hydraulic or electrical, adjusts the vertical position of adjustable circular track element 26, thereby controlling
 15 the symmetrical camber of blades 12. In addition, a horizontal actuator 46 is used to adjust the asymmetrical camber of blades 12 by moving hollow post 28 horizontally relative to blades 12 and mast 20.

A first set of bearings 50 facilitates the rotation of collar 24 about track 34. A second set of bearings 52 facilitates the vertical movement of track element 26 relative to hollow post structure 28.
 20 Finally, a third set of bearings 54 facilitates the horizontal movement of hollow post structure 28 relative to circular plate 38.
 25

It is generally necessary to alter the camber of the blades in response to different flight characteristics. FIGS. 1a and 1b show blades 12 in a flat configuration. This is similar to the shape of
 30 standard helicopter blades. FIGS. 2a and 2b show rotatable blade assembly 10 configured with circular track element 28 lowered relative to mast 20 and blades 12, to cause each blade 12 to deform downwardly at distal end 16. The shape swept out by blades 12 in this
 35 configuration is similar to that of an inverted flying disk and has the similar aerodynamic property of providing lift.

FIGS. 3a and 3b show assembly 10 with hollow post 28 moved to the left to impart an asymmetrical camber to the shape of the virtual lifting body. In this diagram, whichever blade is in the leftmost position will have a downward slope at its distal end, because it will be pulled inwardly by connector 22 which is in turn pulled inwardly due to the position of hollow post 28.

FIGS. 4a and 4b show assembly 10 with circular track element 26 shifted down slightly relative to the position shown in FIGS. 3a and 3b relative to the position, causing both distal ends 16 to be tilted slightly more downwardly. The flexibility of the control of the shape of blades 12 shown in FIGS. 1-4 is useful in the steering and control of the helicopter to which rotatable blade assembly 10 is affixed. Different shapes are used depending on the desired flight characteristics.

FIGS. 5a and 5b show the embodiment and symmetrical camber of FIGS. 1a and 1b but with blades 12 rotating and pulling collar 24 about track 34. This motion is indicated by the pitch of connectors 22. FIGS. 6a and 6b show the same embodiment with camber of FIGS. 4a and 4b imparted to the blades 12 and with blades 12 rotating and pulling collar 24 about track 34.

FIGS. 7a-7b and 8a-8b show an additional preferred embodiment of the present invention. Elements which are similar to elements of FIGS. 1a-4b are referenced by the same number as in FIGS. 1a-4b, but with the addition of a prime mark. As in the embodiment of FIGS. 1-4, the asymmetrical camber of the blades is set by the relative horizontal position of mast 20' with respect to hollow post 28'. Rotatable collar 24', however, is vertically stationary. The symmetric camber of blades 12 is set by vertically moving vertically adjustable eyelets-bearing collar 60 which rotates in tandem with collar 24'. In addition, connectors 22' are prevented from cutting through the air by guidewheels 62 mounted so that they radially project from collar 24'.

Bearings 64 facilitate the rotation of 'Collar 60 whereas bearings 66 facilitate the vertical movement of collar 60.

FIGS. 9a-12b show an additional alternative preferred embodiment. In these drawings, elements which are analogous to elements in FIG. 1-4 are referenced with the same reference numbers, but with the addition of a double prime mark. In this embodiment the camber of the blades is determined by the orientation of a swash plate assembly 72, comprised of nonrotating plate 74, rotating plate 76, bearings 78, and connector attachment sockets 80. Guide wheels 82 attached to blades 12 guide connectors 22'. Two actuators 84 control the vertical position of assembly 72 which determines the symmetric camber of the blades 12 and the orientation of the assembly 72 determines the asymmetric camber of blades 12. In a swash plate assembly 72, as in swash plate assemblies in general, the position of the rotatable plate, relative to the nonrotatable plate is fixed, except that the rotatable plate may rotate freely about its axis of rotation. FIGS. 9a and 9b show blade assembly 10" with swash plate assembly 72 oriented and positioned so that blades 12" have a flat, symmetric camber. FIGS. 10a and 10b show blade assembly 10" with swash plate assembly 72 oriented and positioned so that blades 12" have a symmetric camber and point downward near distal ends 16". FIGS. 11a and 11b show swash plate assembly 72 at an angle, imparting an asymmetric camber to blades 12". Finally, FIGS. 12a and 12b show swash plate assembly 72 at an angle and shifted downward relative to its position in FIGS. 11a and 11b, thereby imparting an asymmetric camber and with distal ends 16" pointing moved downward with respect to their positions in FIGS. 11a and 11b.

FIGS. 13a-13d show a number of different types of rotatable blade assemblies according to the present invention that have rigid blades. Although the tips of

these blades would not be controllable, like the blades of FIGS. 1-12, they would perform the same function of sweeping out a lifting body. The helicopter on which one of these blade assemblies would be attached would have additional means for effecting steering and control functions. Parts in these drawings which are analogous to parts in FIGS. 1-4 are referenced by the same number but with a 1 in front of it 13a, a 2 in front in FIG. 13b, a 3 in front in FIG. 13c and a 4 in front in FIG. 13d. Blades 112 of FIG. 13a turn down slightly near distal end 116, creating a lifting body that is somewhat "frisbee" shaped when spun rapidly. Blades 212 of FIG. 13b have a sharper downward turn toward distal ends 216. Blades 312 of FIG. 13c have both a rigid downward camber over its length and a slight thickening near distal end 316. Blades 412 of FIGS. 13d slope downward from proximal ends 418 to points 498 about three quarters of the way to distal end 416.

It will be obvious to those having skill in the art that many changes may be made to the details of the above-described embodiments of this invention without departing from the underlying principles thereof. The scope of the present invention should, therefore, be determined only by the following claims.

CLAIMS

1. A helicopter blade assembly for permitting rapid forward flight in a helicopter having separate means for providing a forward impetus, comprising:
5 substantially vertical mast; and
a set of rotatable blades which sweep out the shape of a virtual disk having the properties of a lifting body when they are rapidly rotated
10 by the mast.

2. The assembly of claim 1, further comprising means for controlling the camber of the blades, thereby controlling the shape of the virtual
15 disk.

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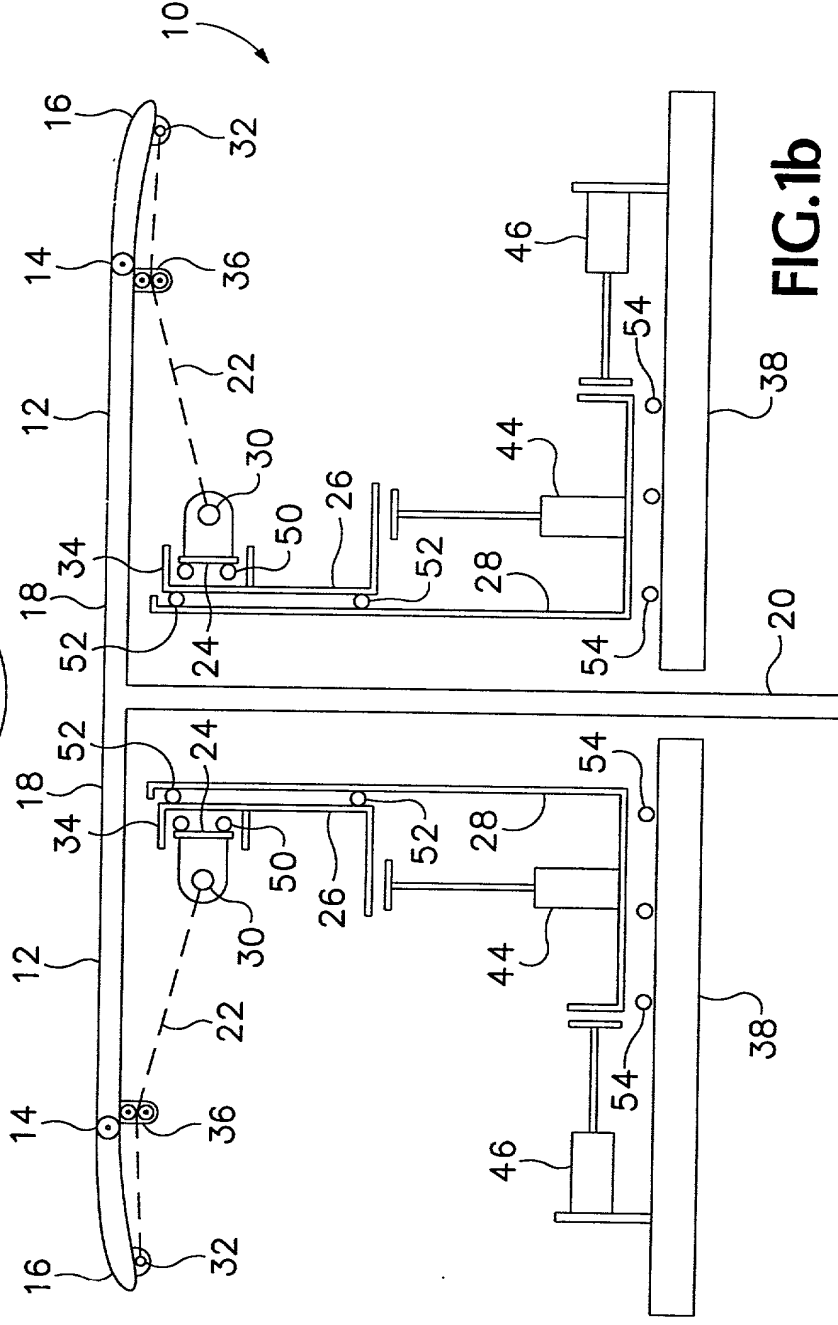
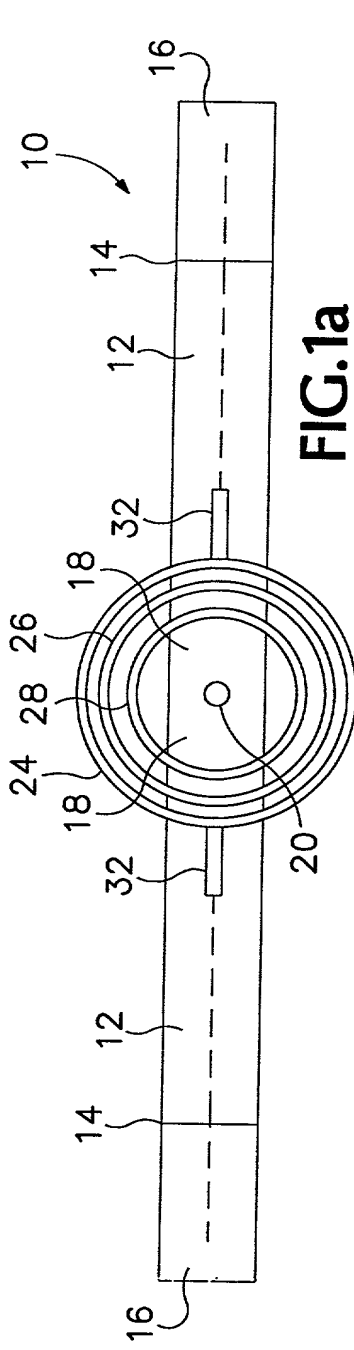
HELICOPTER BLADE ASSEMBLY ADAPTED
TO PERMIT RAPID FORWARD FLIGHT

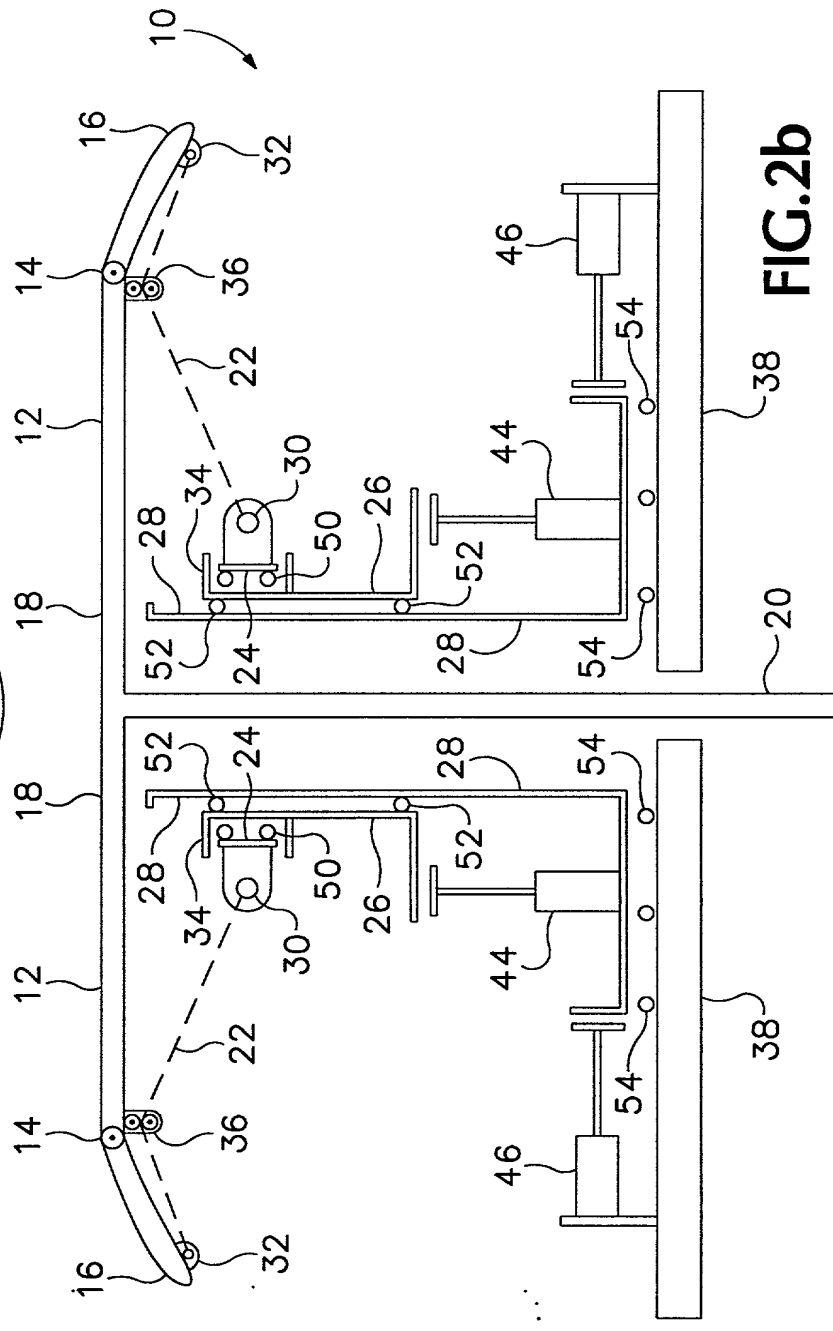
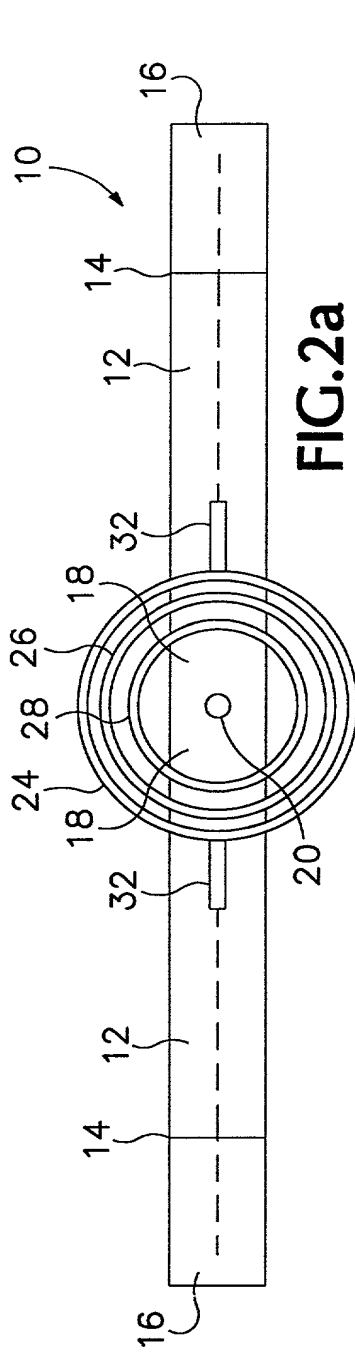
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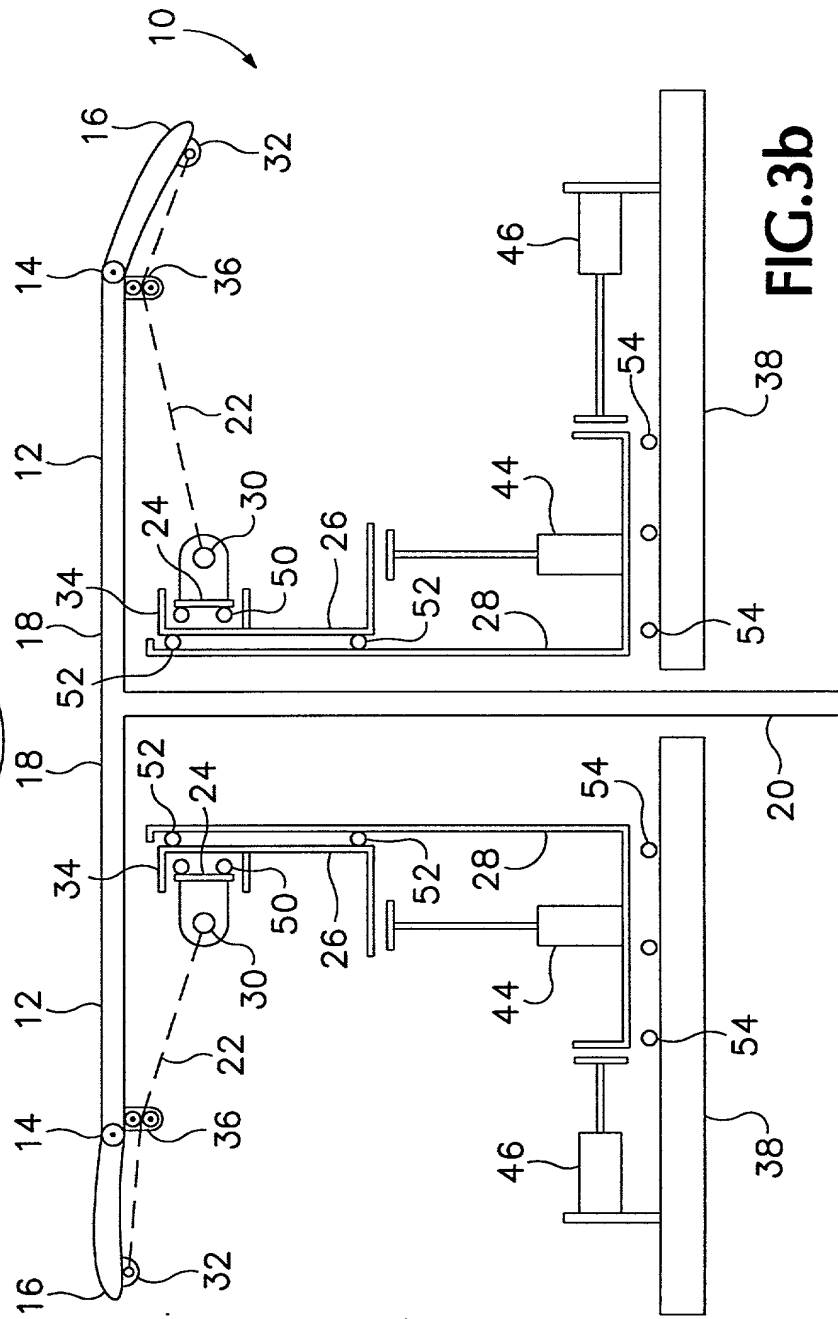
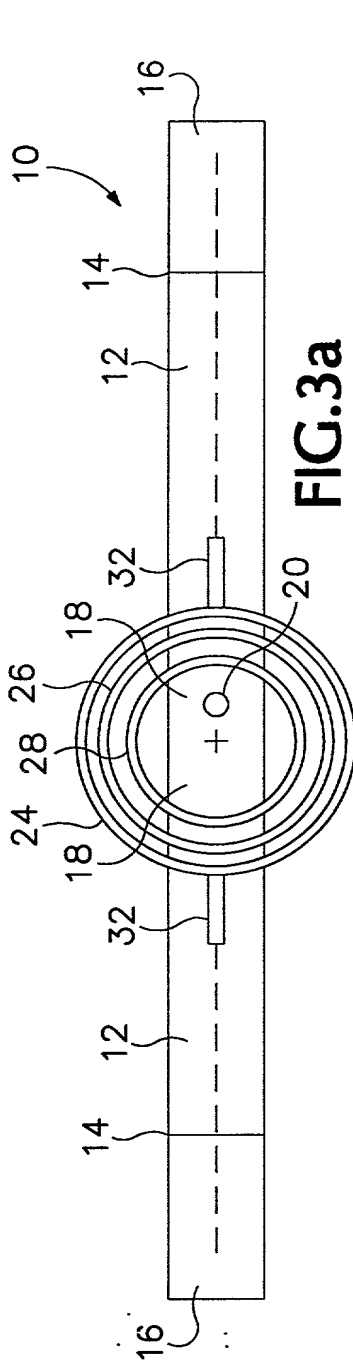
5 A helicopter blade assembly for permitting
rapid forward flight in a helicopter having separate
means for providing a forward impetus is disclosed. The
assembly has a set of rotatable blades attached to a
substantially vertical mast. These blades slope downward
10 near to their distal ends, thereby creating an inverted
disk virtual air foil when the blades are rapidly rotated
by the mast. In a preferred embodiment the camber of the
blades and, therefore, the shape of the virtual air foil
is controllable.

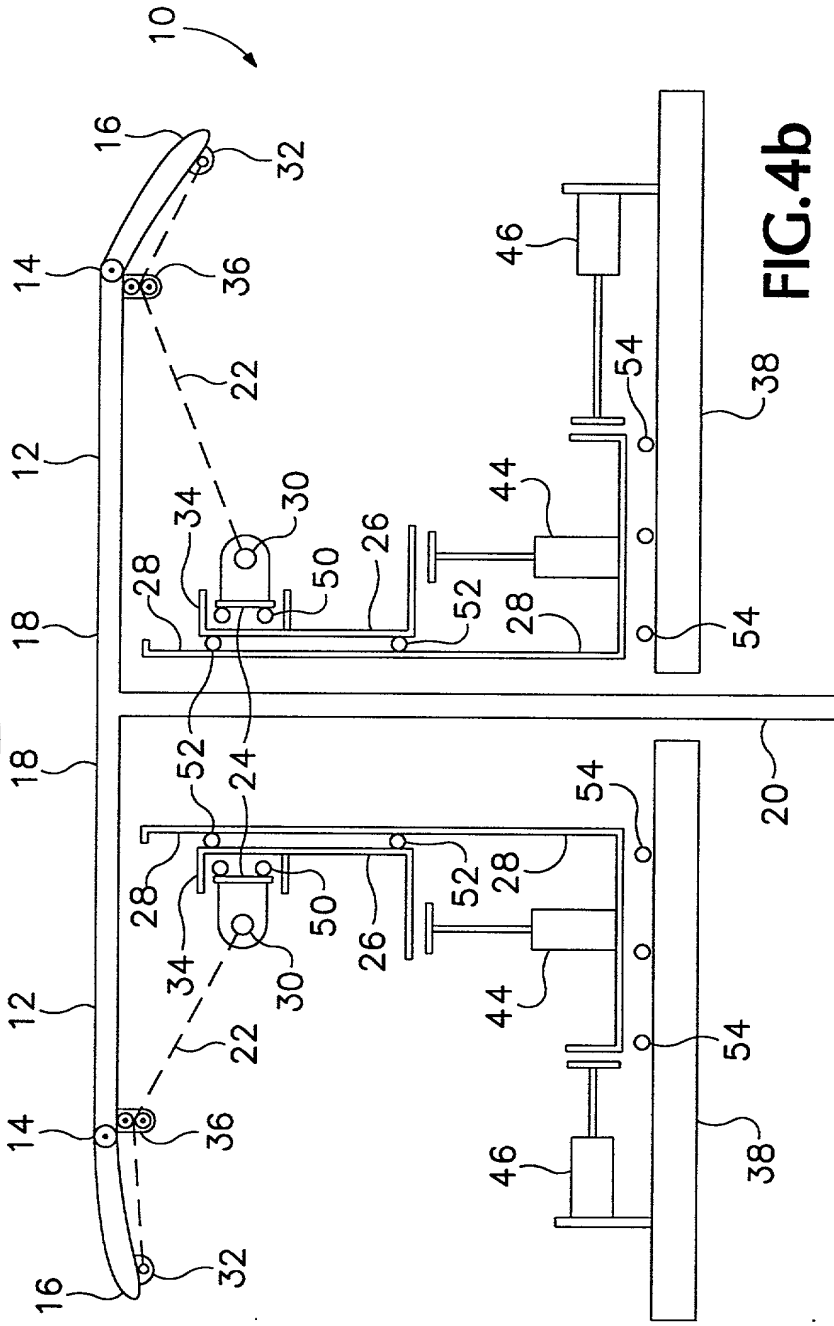
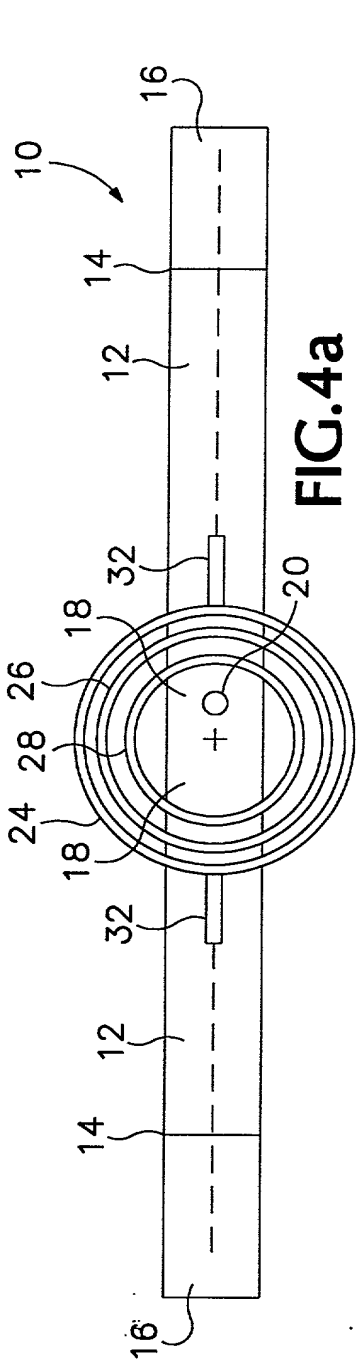
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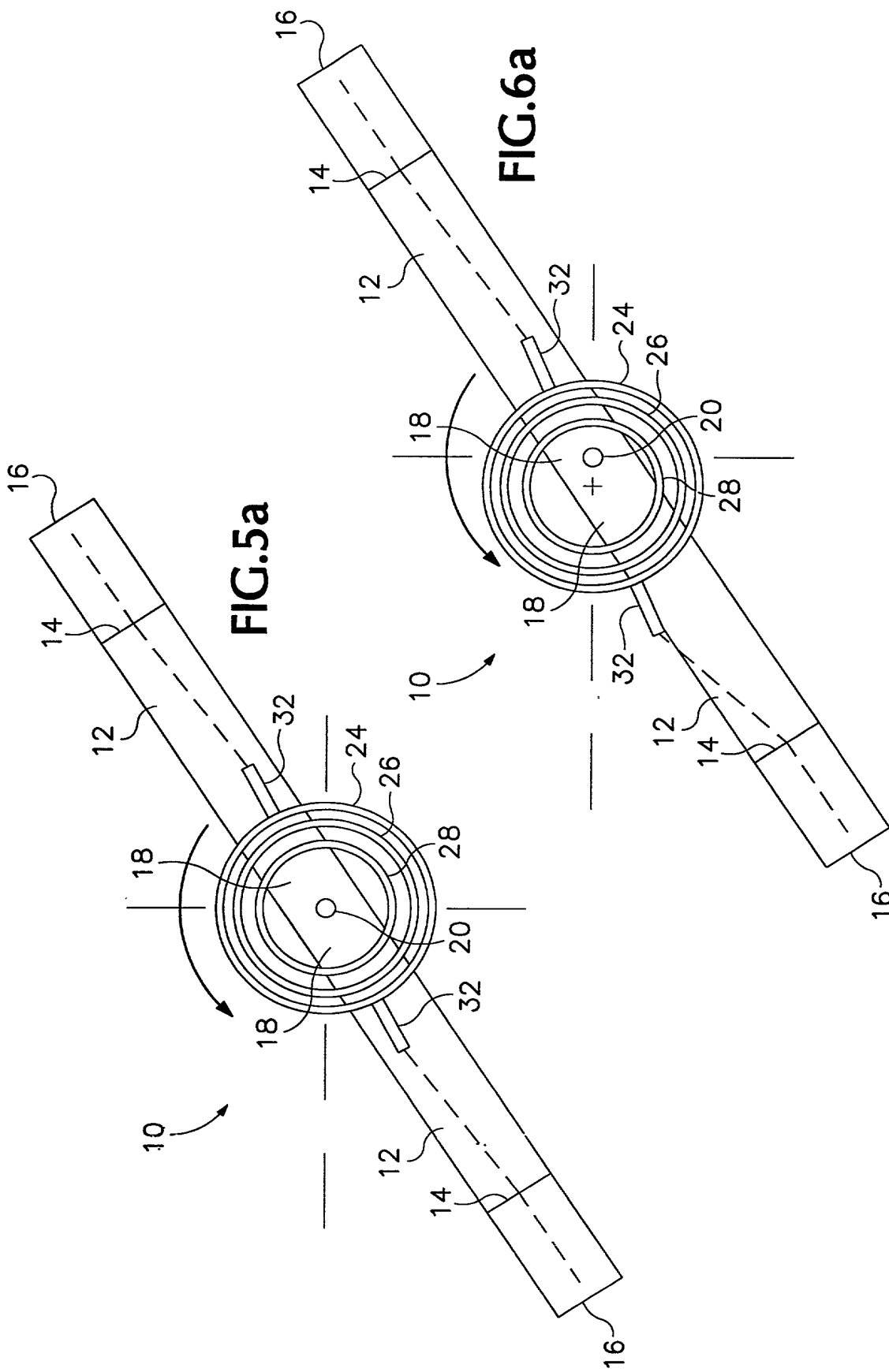
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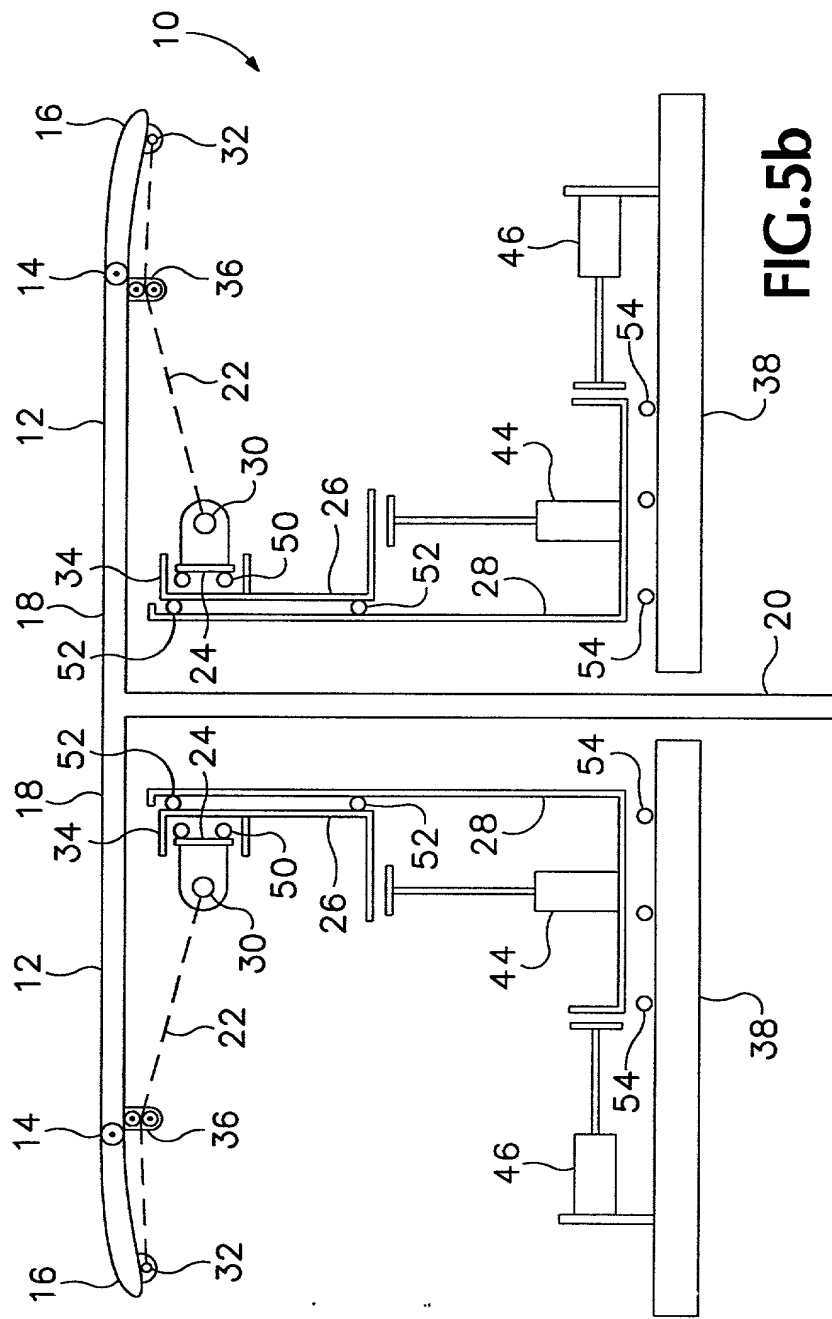


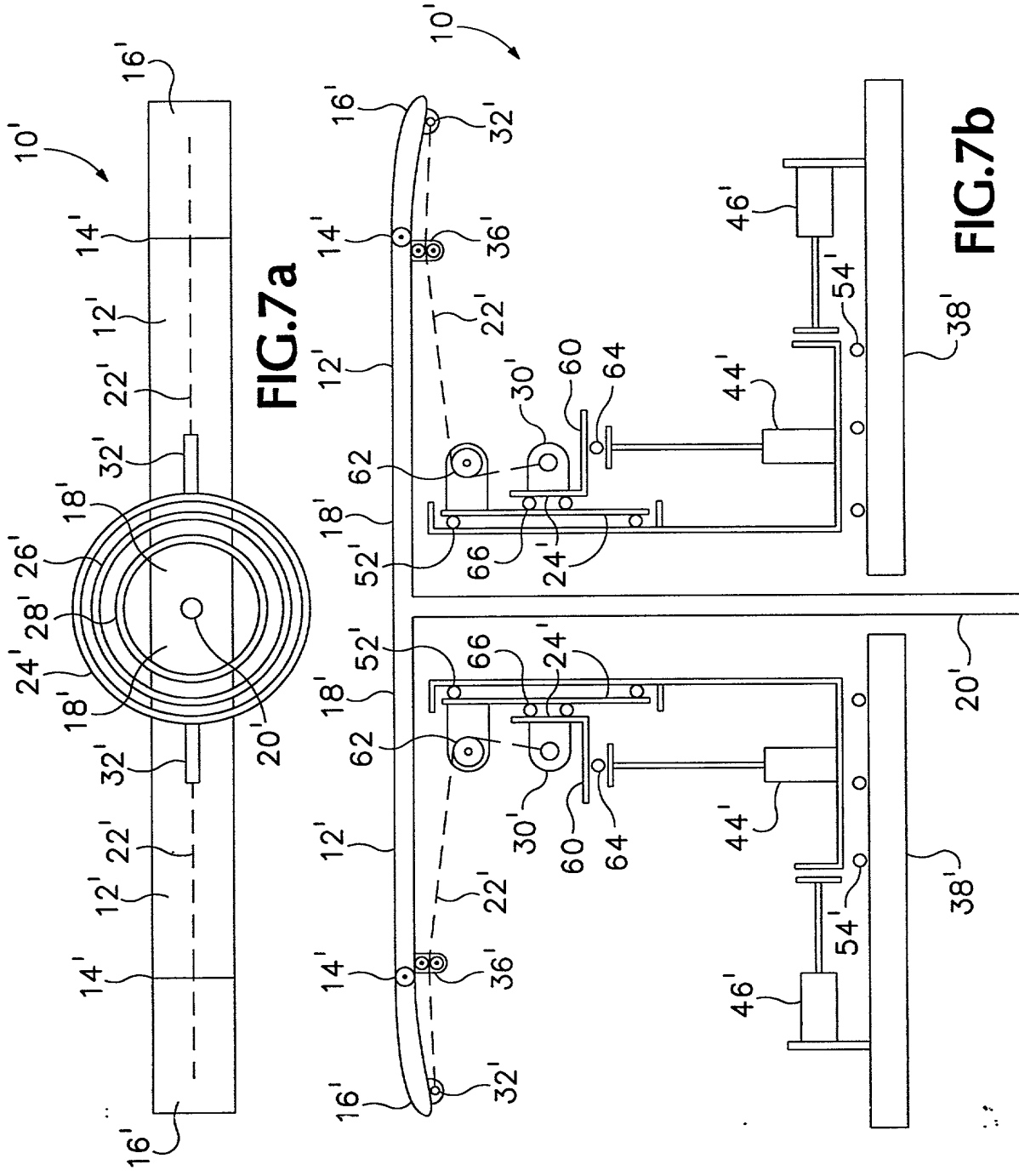


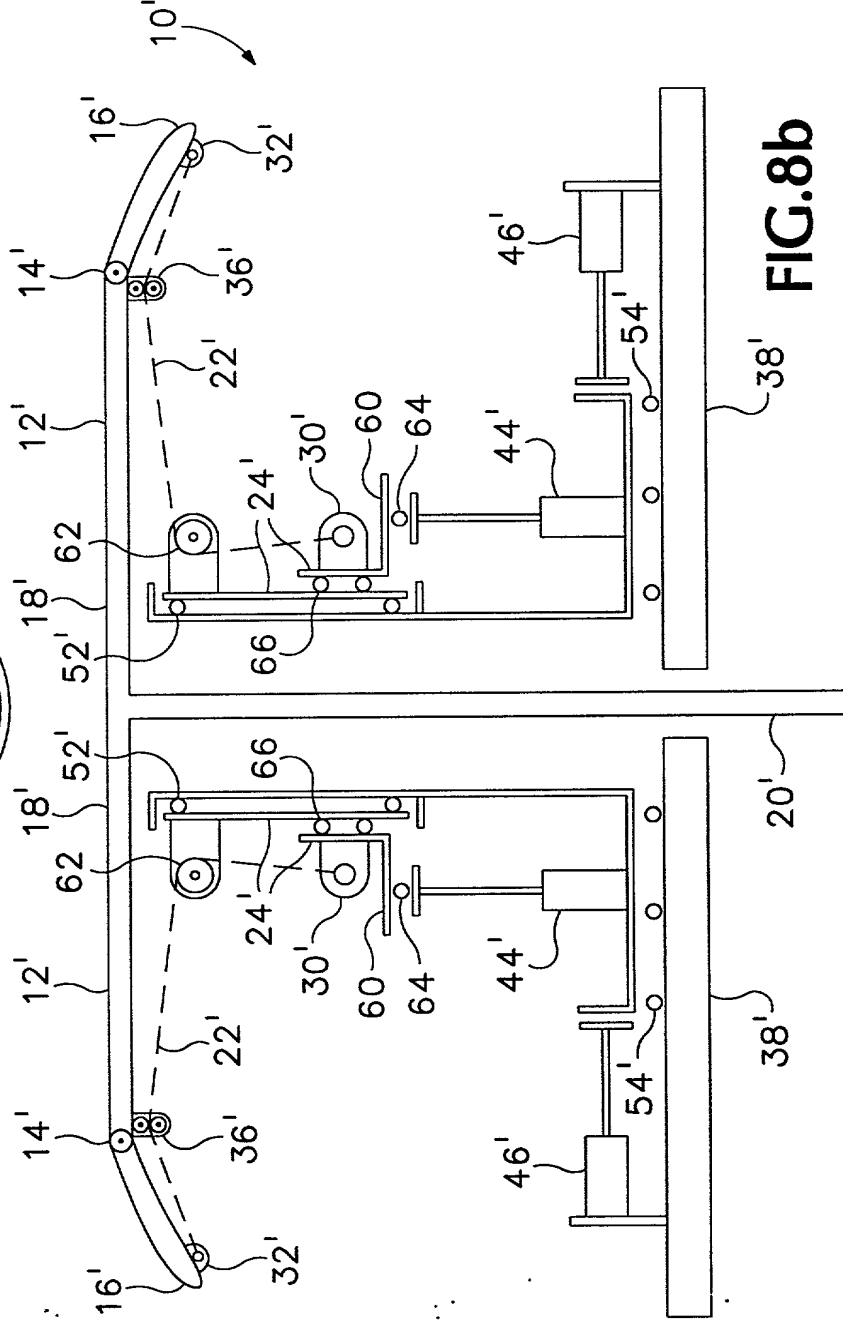
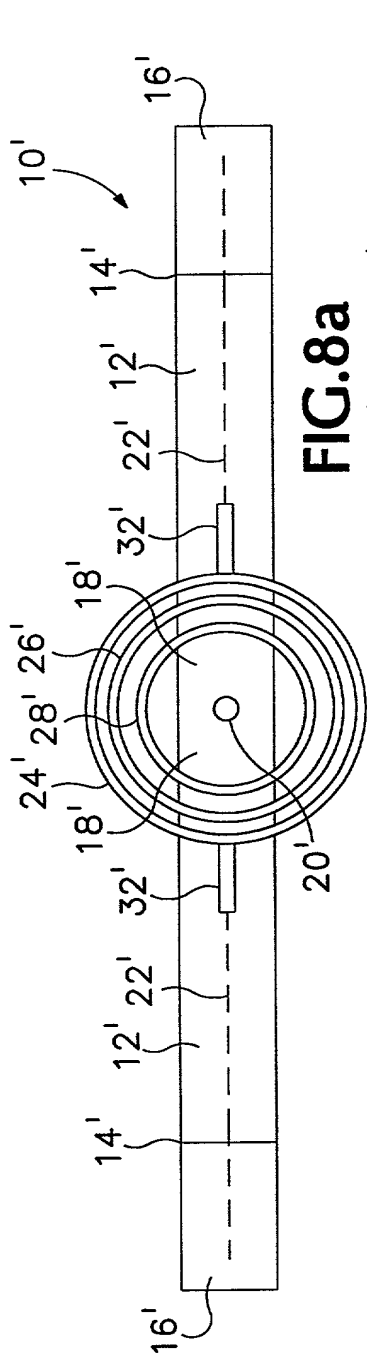


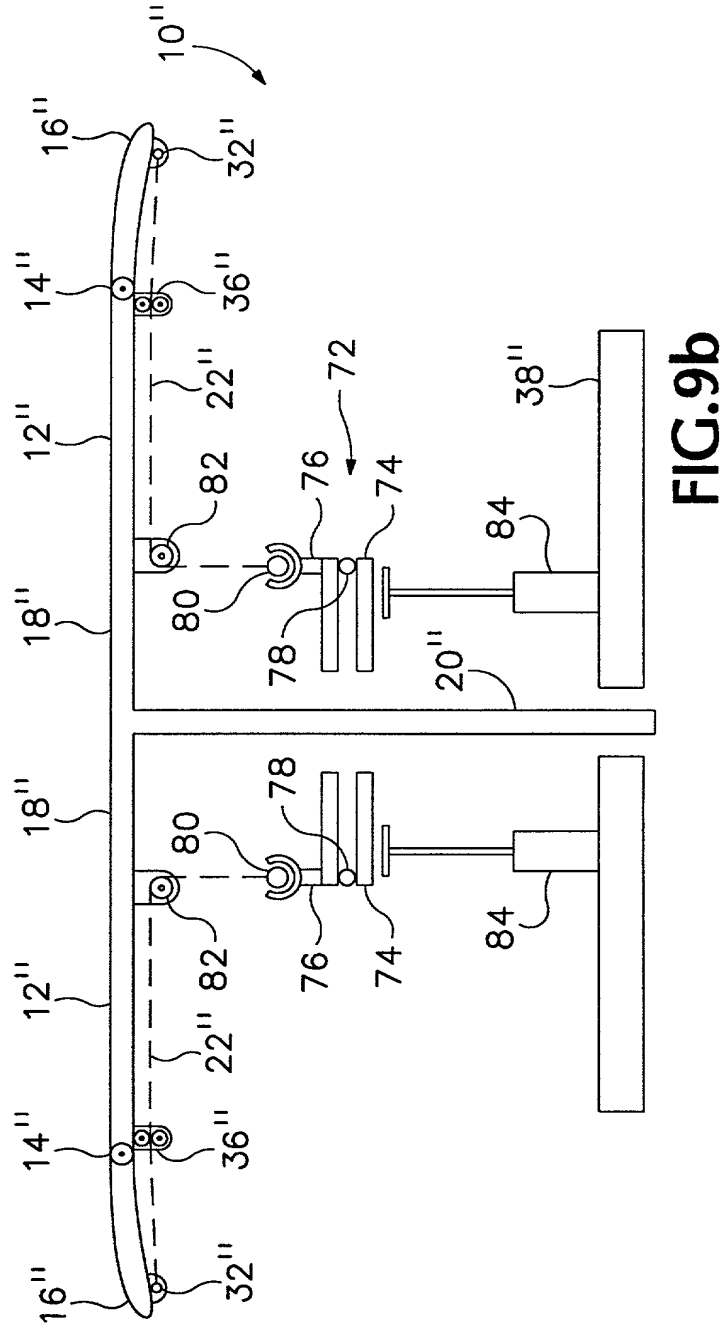
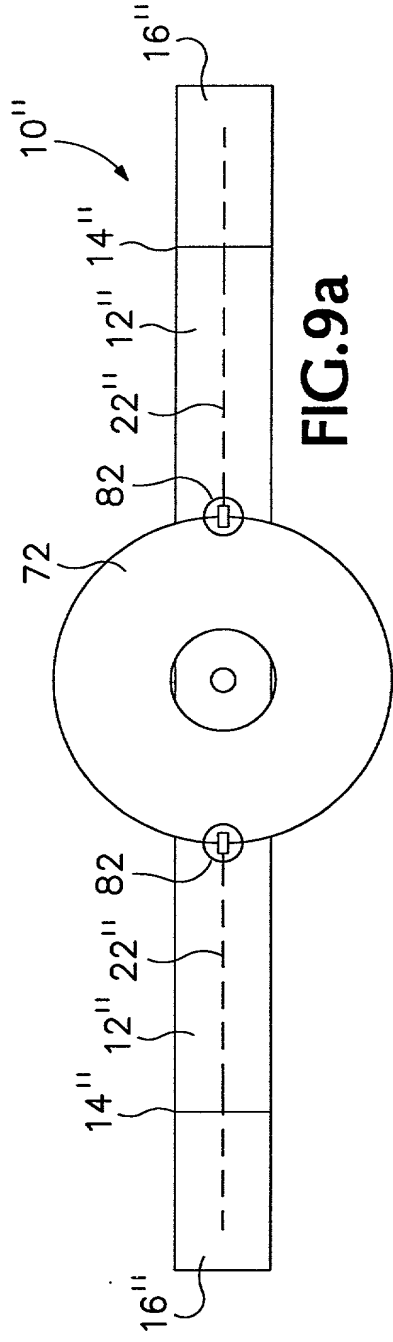












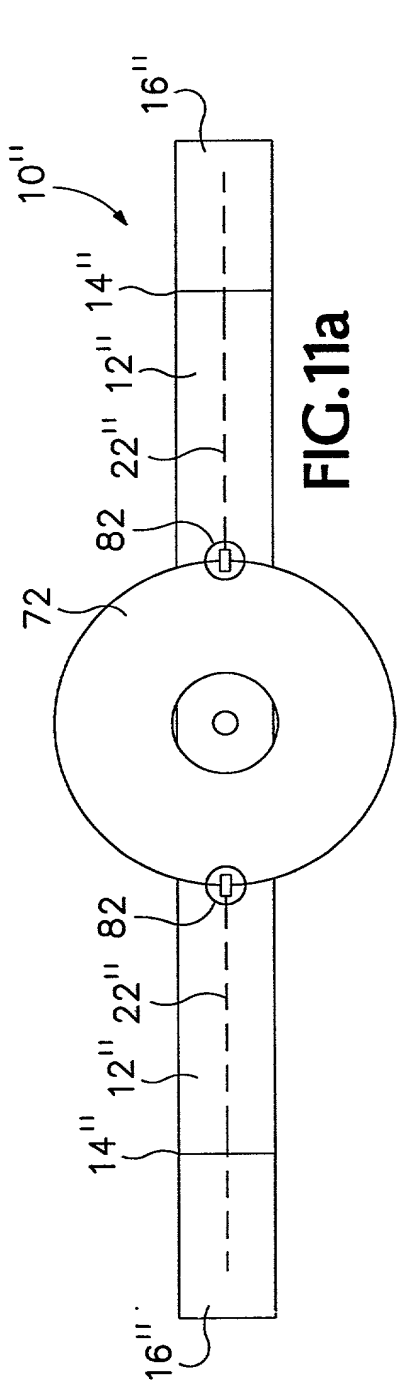


FIG. 11a

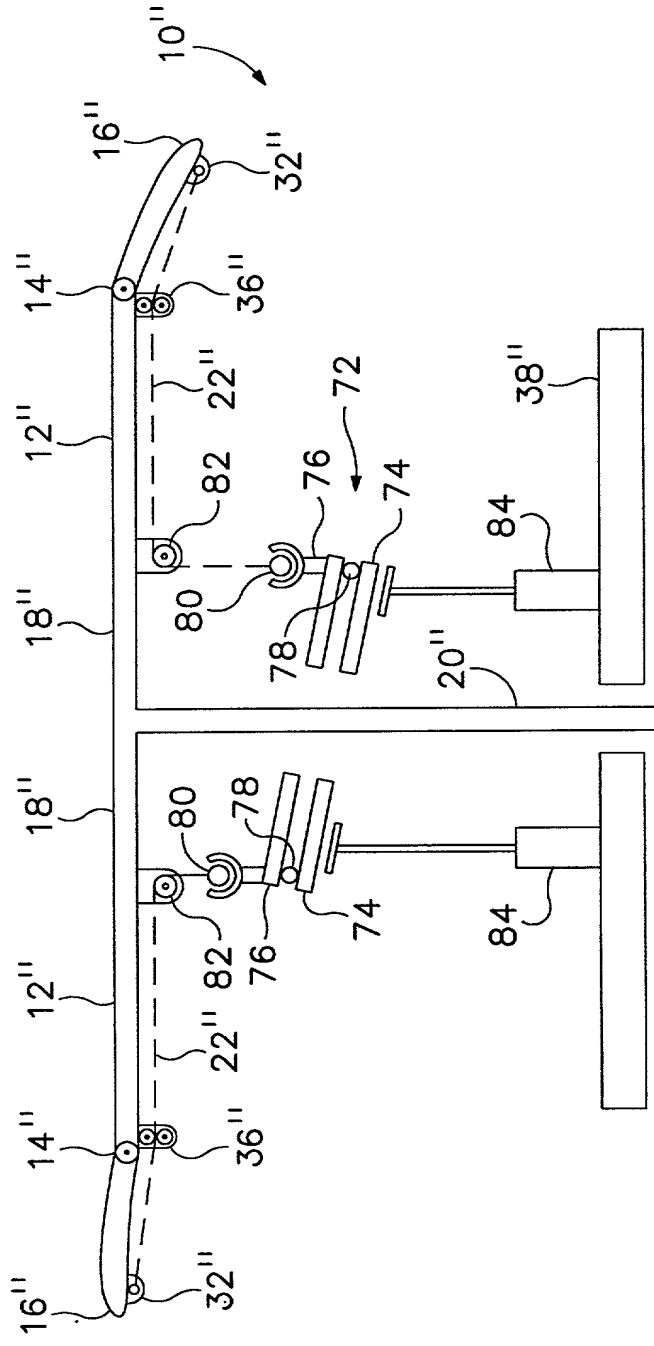
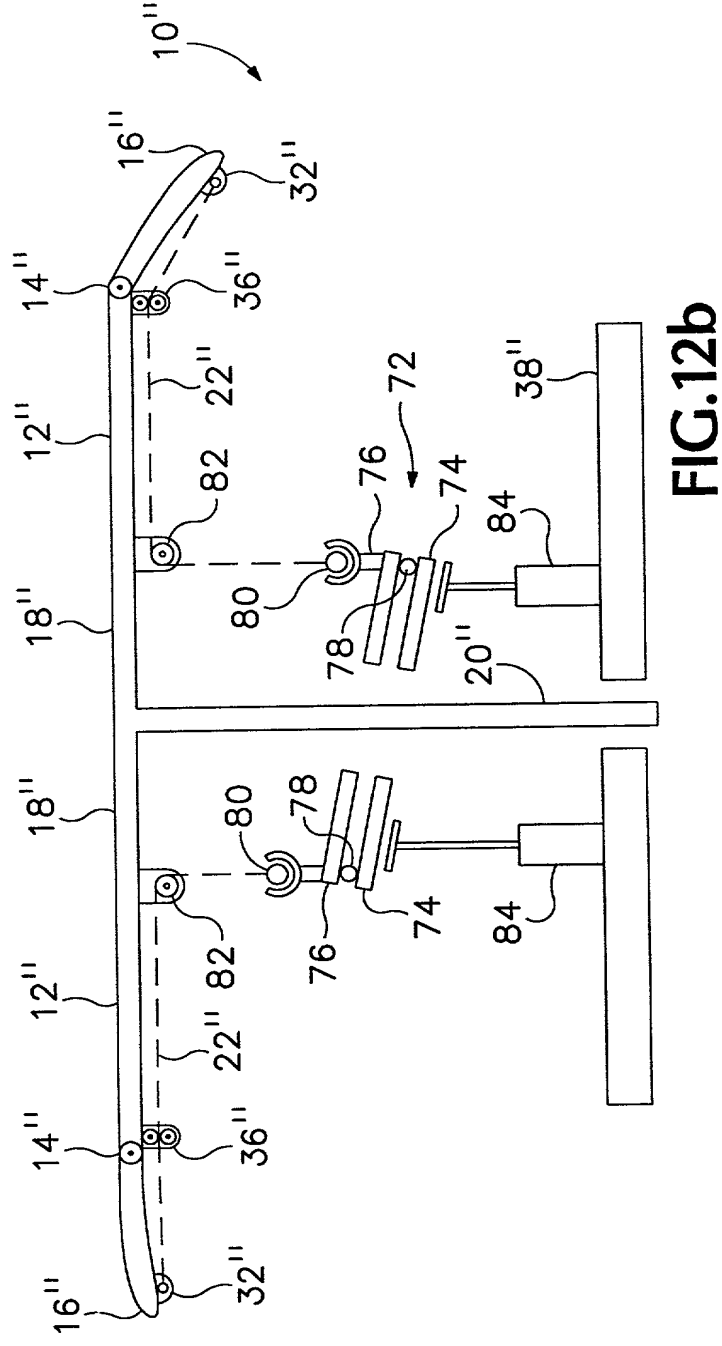
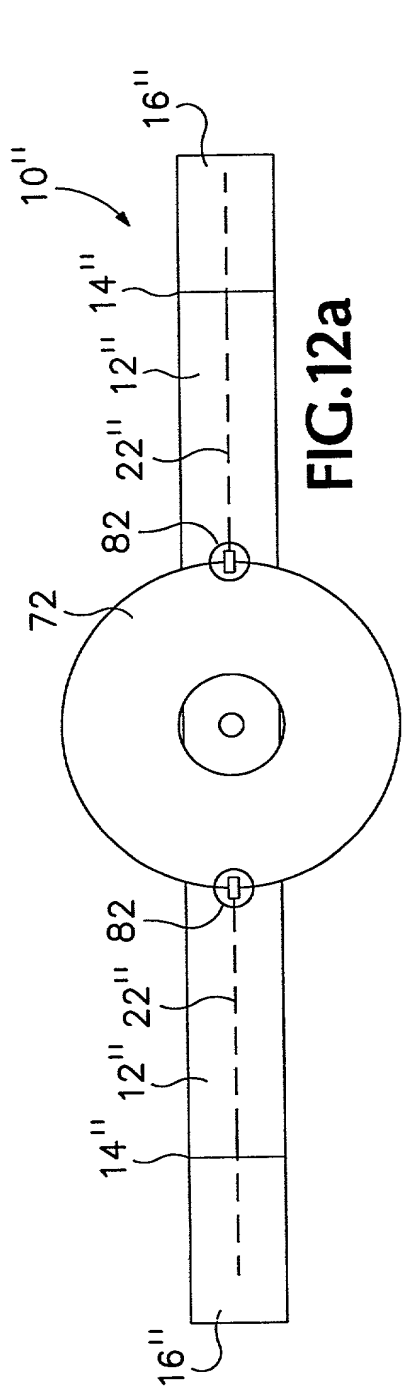
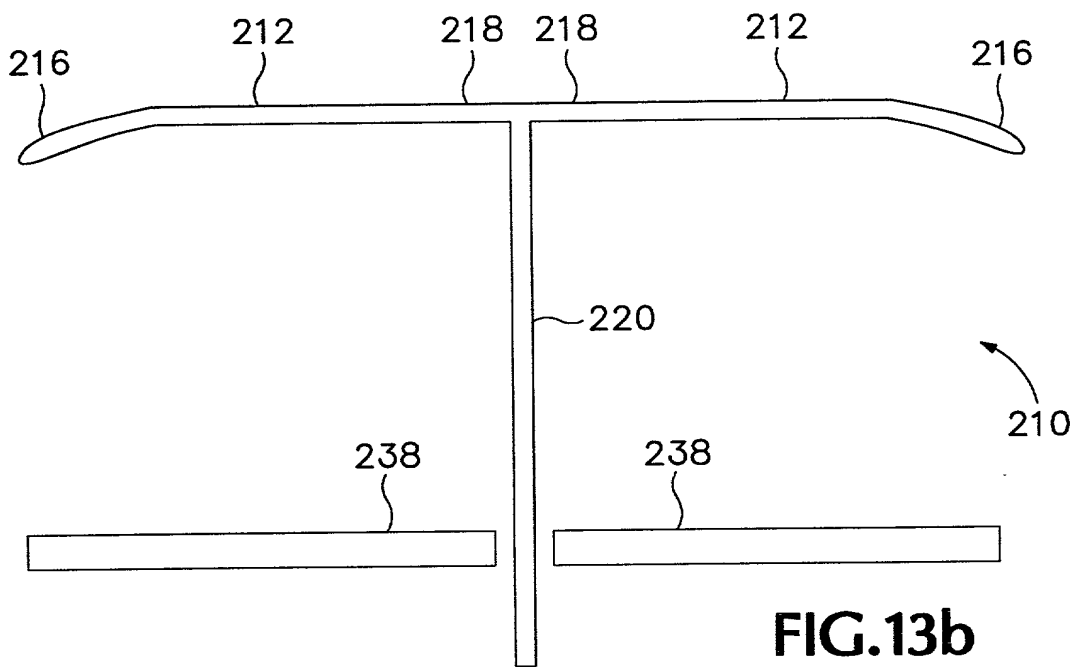
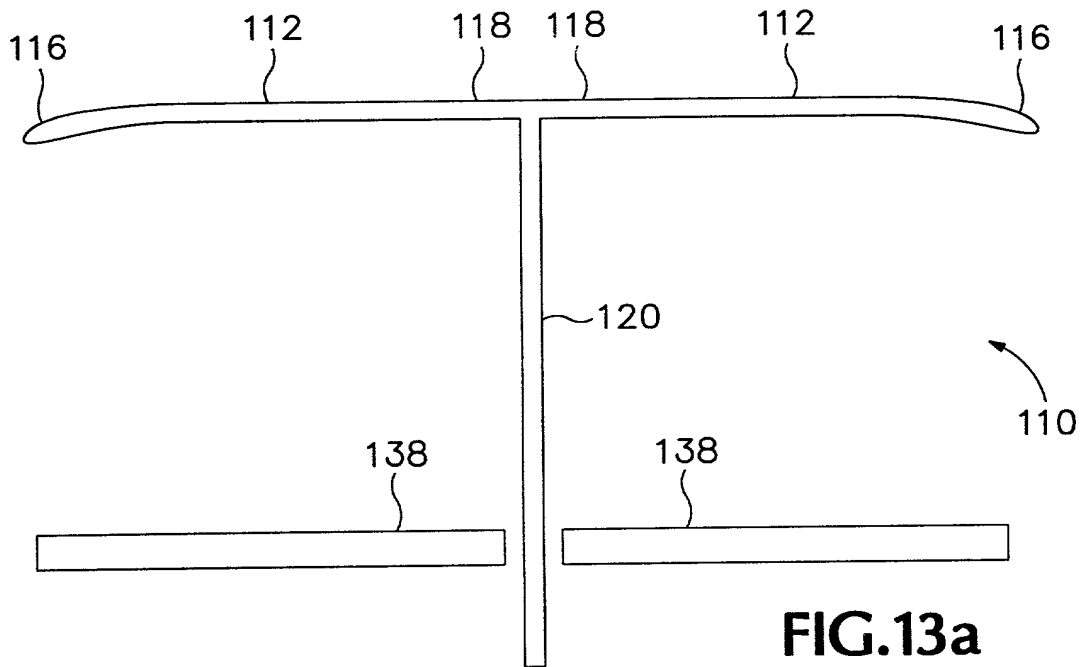
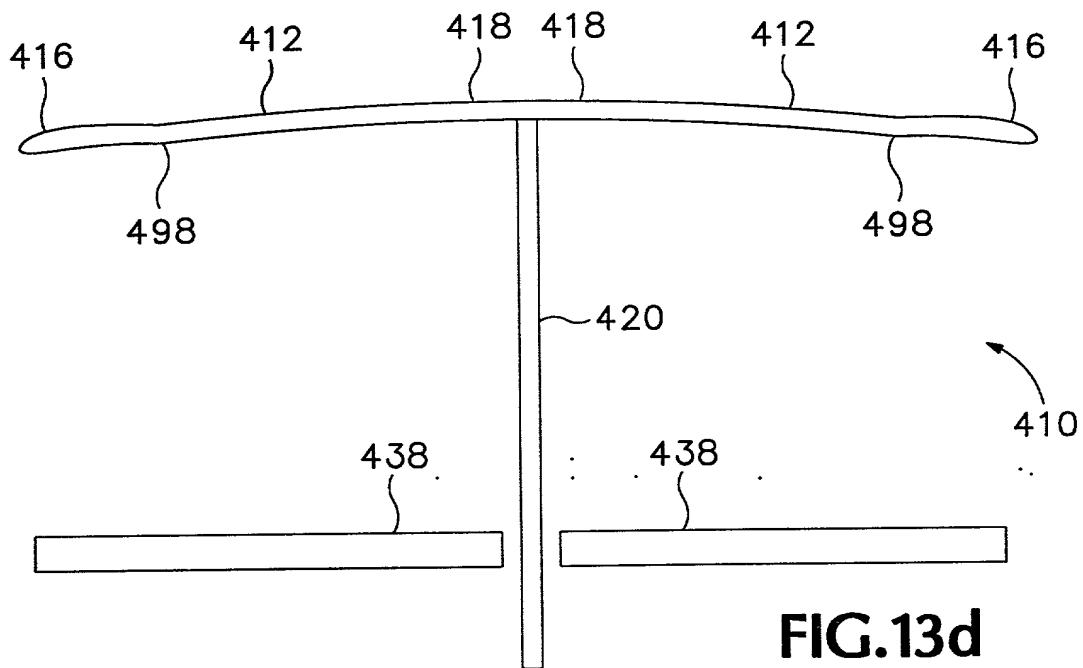
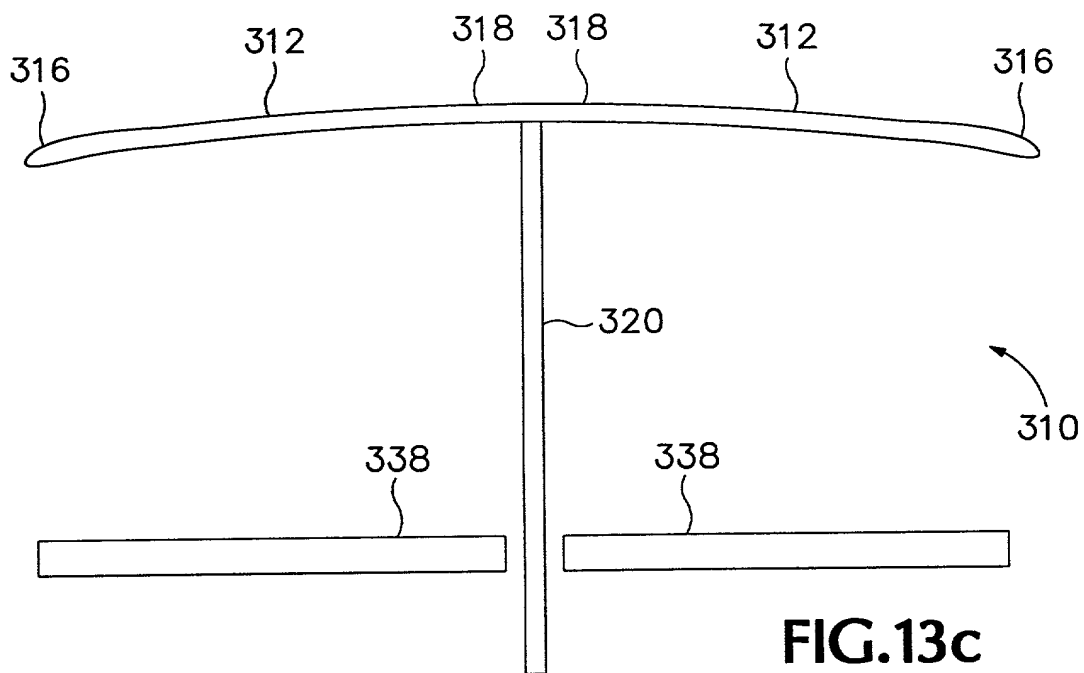


FIG. 11b







COMBINED DECLARATION AND POWER OF ATTORNEY
FOR PATENT APPLICATION

As a below-named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name.

I believe I am the original, first, and sole inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled HELICOPTER BLADE ASSEMBLY ADAPTED TO PERMIT RAPID FORWARD FLIGHT, the specification of which

☒ is attached hereto.

☐ was filed on _____ as United States Patent Application No. or PCT International Application No. _____ and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information that is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code § 119(a)-(d) of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed.

NONE.

I hereby claim the benefit under Title 35, United States Code, § 119(e) of any United States provisional applications(s) listed below:

NONE.

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code § 112, I acknowledge the duty to disclose information that is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56 that became available between the filing date of the prior application and the national or PCT international filing date of this application.

NONE.

I hereby appoint the following attorneys and/or agents to prosecute this application, to file any corresponding international application(s), and to transact all business in the Patent and Trademark Office connected therewith:

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Kent A. Fischmann	35,511
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William J. McNichol, Jr.	31,179
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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of sole inventor: **David Curt Morris**

Inventor's signature:



16 Oct. '96
Date

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